

A CONTRIBUTION TOWARD THE LIFE HISTORY OF EMPHOR BOMBIFORMIS CRESS.

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(WITH PLATE VII.)

Emphor bombiformis Cress.¹ is one of the larger digger bees and is allied to the species of the genus *Melissodes*. It is not ordinarily regarded as common; but is not rare at Arlington, New Jersey, where, in the vicinity of its nesting region, one or two hundred specimens could easily be taken in the course of a day at the proper season. The writer first met with the species in 1909 when several colonies were found at the edge of a cat-tail marsh. In 1910 other colonies were discovered in the same general region. The species seems to prefer hard, shaly soil in which to nest though small colonies occur in sandier soil.

On August 30, 1909, one large colony, comprising perhaps seventy bees, was discovered, which had made one hundred and twenty-seven holes on an area three feet in diameter. Two smaller colonies, one seventy feet and the other twelve feet away from this large one, consisted of about eight and twelve individuals respectively, and a still smaller number of bees constituted a fourth colony between the nearest of these two larger colonies and the very large one.

When first the bees were approached there was great commotion among them; they flew wildly about and buzzed loudly and were so reluctant to enter their burrows that soon the dozen or so at first present was increased to a swarm of about thirty. Quiet ensued in about five minutes. Later in the day my presence was not in the least disturbing to their peace, though usually I remained two feet or more away from the nesting region so as not to interfere with their natural behavior.

Until well into the noon hour their actions were quite inexplicable. Some were constantly leaving the nests and some were returning, the former always empty-handed. Usually on returning they would

¹ Determination made by Henry L. Viereck, Washington, D. C.

immediately enter one of the holes, sometimes after describing a few small circles over the entrance, remain there for a short time, and leave again. Others would rest lazily at the entrance of their burrows, with head and fore part of thorax out, and retire only to reappear in a few moments or fly away. A few others, after a great deal of buzzing, would walk over the pellets rejected in the construction of the holes as if in search of something, but would finally fly away without having accomplished anything. Still others walked about aimlessly or were extremely busy peering into or examining the burrows of their neighbors, entering first one, then another, but remaining in them only for a few moments at most. Occasionally, after entering a burrow, one would back out hurriedly as if pursued, though I saw no pursuer; at other times one would be met at the entrance by what was presumably the rightful occupant and owner of the nest, who really appeared to look savage, and in such cases the intruder made haste to move on.

One individual actually entered sixteen holes before finally flying off. The burrow of this bee, it appeared, had been damaged, as several times the bee returned to a broken nest, removed part of the débris and then went off investigating again.

In beginning a burrow the bee with its fore legs digs furiously in the thin layer of sod material, brushing the fragments away with its hind legs and meanwhile turning around constantly and standing almost on its head as it were. When the hole has attained a depth of half an inch, soil is reached, and then a different method of working is begun. The soil is now moistened with saliva, small pieces are then bitten off with the mandibles and passed upward to the hind legs where with the assistance of the abdomen it is placed at the entrance of the hole. As pellet after pellet is placed in position the bee turns round and round making one circuit in about one minute and a half, and, with the abdomen partly bent under on the venter and moving from side to side, smooths down the interior of the growing turret. During this process the bee now and then emerges from the burrow and standing clumsily over the half completed turret cleans its antennæ with its fore legs, and the hind legs with each other. When the turret has reached a height equal to one-half inch, building ceases, but the work of excavation goes on and the pellets, now larger, are brought to the top of the turret, with the hind legs as usual, and

forcibly ejected over the rim. Sometimes the pellets are thrown to a distance of only half an inch, but usually one or two inches or, in rare instances, four inches. Occasionally a pellet is thrown into the burrow of another bee and if the latter is also digging the pellet is simply removed like the others by being brought to the surface with the hind legs. Frequently, however, the mouth is used and the pellet tossed over the top of the turret.

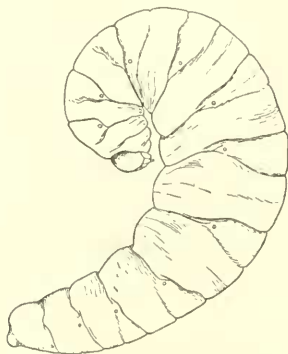


FIG. 1. Larva of *Emphor bombiformis* Cress.

The burrows when completed are somewhat more than one fourth inch wide and of varying depth, two and one half inches being about the average depth though some are four inches deep and others less than one inch. At the bottom the burrow is widened into a cell.

Not infrequently the bee encounters difficulties in commencing a burrow. In the center of the colony where the holes are most numerous the pellets are littered over the ground to such an extent that frequently only the rim of the highest turret is visible. Instead of extending the colony by working at its outer borders a bee occasionally digs among these pellets and, as fast as the dry pellets are pushed aside, others roll into the forming hole, and it is only after great exertion that a good beginning is effected: sometimes the project is abandoned in these places and a new hole started somewhere else.

At one time a bee was observed repairing a turret which was slightly broken and partly covered over with pellets. On first returning, the nest was not positively identified by the bee; it made a

hasty survey of the wreck, flew away in a zig-zag manner, rapidly examining other nests in the vicinity and returned to the broken one. This was repeated several times. Twice during these performances it engaged in momentary combat with another bee as though the latter were in some way responsible for the destruction of the nest. Finally it began to clear away the wreckage in mad haste, and when this had been done, peered into the hole and walked leisurely in. A little later it brought bits of mud from below in its mandibles and began mending the broken turret.

When the cell is completed it is provisioned with pollen, and it is a noticeable fact that pollen laden bees locate their burrows immediately. There was no uncertainty displayed as in the morning hours, when no pollen was gathered and no preliminary buzzing or circling about; but one direct flight to the entrance of the burrow where the bee plunged in and disappeared instantly.

The first bee that arrived with pollen, it is true, buzzed around in large circles before entering; but that was undoubtedly because of my close proximity to the nest at the time.

The bright yellow pollen is gathered from the swamp rose mallow (*Hibiscus moschatus*) and carried in surprisingly large flocculent masses on the hind legs. Rarely small flakes are dropped in flight or brushed off at the entrance of the nest, but this is unusual for as a rule the little worker knows how to manage her load.

Despite the large size of the individual loads of pollen carried, quite a number of trips are made before sufficient material is collected to form the solid pollen ball into which the masses are finally shaped. One bee provisioned its burrow in exactly thirty six minutes after she arrived with the first load—an average, allowing three minutes for the gathering of load number one—of about four minutes to the load. Rarely did she stay more than one minute in the nest. When the tenth load had been deposited she flew away and did not return until ten minutes had passed; then after a momentary examination of the interior of the nest departed again and returned after fifteen minutes. Finally she flew away again and I saw no more of her.

Into one burrow three loads of pollen were taken at about one minute intervals. This bee, it appeared, was exceptionally industrious and attention was centered on this one burrow. Soon a fourth load

was taken in and as the carrier left, another bee, also laden with pollen, entered. Again the first bee came, and as she was in the hole number two arrived and entered also. Both came out hurriedly, one obviously in pursuit of the other; around and around they buzzed, finally clenched, rolled over on the ground, separated, and then both departed. Presently, however, one returned, undoubtedly the owner of the nest, and rapidly removed three tremendous loads of pollen from the burrow, two of which were dropped intentionally or unintentionally a short distance from the entrance, and the third of which was carried away.



FIG. 2. Pupa of *Emphor bombiformis* Cress.

Digging into several of the burrows, pollen in the same loose condition as when first carried in was found in some, and in others the ready-formed three-eighth-inch pollen ball. This ball was less than one fourth the size of the pollen mass used to form it. To one a single slender, elongated, curved egg was attached and on another a small larva was feeding. The burrows, it appears, are not covered up after the egg is laid, as this egg and larva were dug from open burrows; and besides I saw nothing that looked like a covered burrow.

Twice during the afternoon spent in watching the bees a little wasp, which Mr. Viereck determines as *Lyroda subita* Say, alighted among the nests and, nervously walking about, entered one burrow after the other, occasionally remaining in one for the greater part of a minute. By its peculiar actions I supposed it to be parasitic on

the larva of the bee, or an inquiline in its nest; but the life history of this wasp as given by the Peckhams is so entirely different, that one simply wonders what it was doing among the nests of *bombiformis*.

In the following year, March 26, 1910, the first trip of the series I proposed to take to the camping ground of the bees was made, and about one square foot of soil was dug over and carefully examined. Old cocoons, most of them filled with earth and as hard as the packed shale imbedding them, were obtained in great numbers, no less than one hundred and sixty being found in the square foot of earth examined. These undoubtedly represented the empty cocoons of years' accumulation. Apart from this number of old cocoons, six new ones were found, and these, unlike the others, were of an ochre color, in appearance much like the original pollen ball stored by the bee but larger, and they rolled out of their cells as they were freed from earth on one side. Of the six cocoons five contained large white larvæ with the head and thorax bent under against the venter as shown in Fig. 1. Nothing was left of the pollen ball, and apparently the larva merely awaited the advent of warm weather to change to a pupa and eventually to an adult. The other cocoon contained a dead larva, shrivelled, and to some extent covered with fungus.

On April 27 a second visit to the place was made and this time the entire ground inhabited by the largest of the three colonies was dug over. Old cocoons were present by the hundred, but only twenty-one good ones were secured. Also, about thirty pollen balls, untouched in any way, were obtained. Either the adult female neglected to place her egg upon these, or the egg, in case it was deposited, failed to hatch, or the larva died at a very early stage of its existence. No indications of Meloid beetles, which it was the special object of digging up the entire area to secure, were seen.

A few of the larvæ secured on this trip were preserved, but the majority of cocoons were buried intact beneath an inch or less of loose sand with a view to rearing the adults. These were then left by themselves without as much as an occasional wetting (except that on June 10, one cocoon was opened to note the condition of the larva) and on July 11 the first bee, a male, emerged. A cocoon was immediately dug up and the pupa sketched. This presented an appearance shown in Fig. 2. Other adults, numbering six in all, emerged up till July 20, two appearing on this date, and all of them females.

On July 21 another visit to the region of the colonies was made to get males, if possible, but no bees of either sex were seen. On the 22d of August, however, the bees were out in full force, but only females were noticed. On this trip numbers of the bees were found flying over a road-side puddle on which they alighted and were blown over its surface by the wind to the opposite side. This seemed to be done for mere sport for as soon as the leeward side was reached they rose and flew to the windward side, alighting as before. Whether or not they actually lapped up water with which to moisten the soil when digging their burrows I was unable to observe, as the wind wafted them so rapidly across the small pool, but I rather suspect that this was the case.

Besides the colonies located the year before no less than five others were discovered, none of them, however, so large as the principal one by the meadow. These new colonies were fully a quarter of a mile from the marsh, and two of them were in a steep embankment.

On a fifth trip, on Sept. 3, the region was visited once more, but the bees were all gone. Scarcely a turret survived the almost daily showers of the ten previous days, and irregular holes merely marked the entrances to the cells. Quite a number of the burrows were uncovered and larvæ from one fourth to nearly full grown were found coiled around the moist and slimy pollen ball which had decreased in size in proportion as the larva had increased.

Though larvæ were not rare, fully 95 per cent. were dead as the result of mould due to the continuous humid condition of the atmosphere. It will be interesting to note whether on this account the bees will be reduced in numbers in 1911.

EXPLANATION OF PLATE VII.

- Fig. 1. *Emphor bombiformis*, female.
 - Fig. 2. *Emphor bombiformis*, male.
 - Fig. 3. Plaster casts of burrows.
 - Fig. 4. Turrets from the entrances to the burrows.
 - Fig. 5. Pellets ejected in digging the burrow.
 - Fig. 6. Pollen balls.
 - Fig. 7. Pollen ball *in situ*.
 - Fig. 8. Cocoons.
- All natural size.